MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

EEM1016 – ENGINEERING MATHEMATICS I
(ME/ RE / TE)

14 OCTOBER 2019

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1.This Question paper consists of 4 pages (including cover page) with 5 Questions only.

2. Attempt **ALL**questions. The distribution of the marks for each question is given.

3. Please writeall your answers in the answer booklet provided.

Question 1

(a)   Evaluate $\lim\limits_{x \to 2} \dfrac{\sin(x-2)}{2x^2 - 4x}$ [3 marks]

(b)   Evaluate the following integrals.

   (i) $\int_0^1 \dfrac{1}{(2x+1)(x+3)}\, dx$ [5 marks]

   (ii) $\int \dfrac{2x^2}{3x^3 - 1}\, dx$ [5 marks]

(c)   Find the local extreme values of the following function:
$f(x) = 3x^4 + 2x^3 - 9x^2 + 1$ [7 marks]

Question 2

A periodic function $f(x)$ is defined within the period $-1 < x < 1$ by

$$f(x) = \begin{cases} 4 & (-1 < x < 0) \\ -4 & (0 < x < 1) \end{cases}$$
$$f(x+2) = f(x)$$

(a)   Sketch a graph of $f(x)$ for $-4 < x < 4$.   [3 marks]

(b)   Is $f(x)$ an even or odd function or neither? Explain your answer.   [2 marks]

(c)   Find the Fourier coefficients(a_0, a_n, and b_n) of $f(x)$.   [11 marks]

(d)   Find its Fourier series expansion.   [2 marks]

(e) To what value will the Fourier series converge by taking $x = \dfrac{1}{2}$?   [2 marks]

Continued...

Question 3

(a)   Find the limit of the following sequence and determine whether it is convergent or divergent.

$$a_n = \lim_{n \to +\infty} \frac{2n^3 + 5n}{n^4 + 4n + 8}$$ [3 marks]

(b)   Determine thefollowing seriesis convergence or divergence. (Hint: use Ratio Test)

$$\sum_{n=1}^{\infty} \frac{(-6)^n}{(n+1)!}$$ [6 marks]

(c)   Determine the radius and interval of convergence atthe following power series.

(i) $\sum_{n=0}^{\infty} \frac{1}{(n+1)!} x^n$ (ii) $\sum_{n=0}^{\infty} n! x^n$ [11 marks]

Question 4

(a)   Let $z = \frac{2+i}{2-2i}$ and $w = \frac{2-3i}{2+2i}$, find $z + w$ and $z - w$.   [4 marks]

(b)   Given that $z = -1+4i$, determine the square roots of z.   [4 marks]

(c)   Given that vectors $\mathbf{a} = \hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 3\hat{\mathbf{k}}$ and $\mathbf{b} = 2\hat{\mathbf{i}} + \hat{\mathbf{j}} + 2\hat{\mathbf{k}}$ respectively.

(i)   Find the vector productof $\mathbf{a} \times \mathbf{b}$.   [3 marks]

(ii)   Find the dot product of $\mathbf{a} \cdot \mathbf{b}$ and the angle between $\mathbf{a}$ and $\mathbf{b}$.   [4 marks]

(d)   Let $A(0,2,1)$, $B(1,-2,3)$ and $C(1,0,1)$ be the three points on a plane. Find the equation of a plane that contains those points.   [5 marks]

Continued...

Question 5

(a)   Find $\dfrac{\partial^2 f}{\partial x^2}, \dfrac{\partial^2 f}{\partial y^2}$ and $\dfrac{\partial^2 f}{\partial x \partial y}$ for the function $f(x, y) = 4x^2 + 2y^2 + \dfrac{1}{x^2} e^{2y}$.

[5 marks]

(b)   (i) Find an equation of tangent plane to the following function,

$z = \sqrt{8 - 4x^2 - y^2}$ at the given point (1, 0).   [5 marks]

(ii) Use the answer of part (i) to approximate $f(0.95, -0.05)$.   [1 marks]

(c)   Use Lagrange multipliers to find the maximum of the following function subject to the given constraint.

$$f(x, y) = x^2 + 6y^2; \qquad 2x - y = 2.$$

[9 marks]

End of Paper